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**PATENT  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant : FRUTH et al.  
Appl. No. : To Be Assigned Examiner: To Be Assigned  
Filed : April 28, 2000 Art Unit: To Be Assigned  
For : REAL TIME FAX-OVER-PACKET PACKET LOSS COMPENSATION  
Attorney Docket Number: 1.068US

**REQUEST FOR FORMAL PATENT APPLICATION**

Assistant Commissioner for Patents  
Box PATENT APPLICATION  
Washington, D.C. 20231

Sir:

Enclosed is a new patent application for filing today. The details regarding this application are as follows.

**Title:** REAL TIME FAX-OVER-PACKET PACKET LOSS  
COMPENSATION

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Attached is an application for patent including specification, claims, abstract of the disclosure, one sheet of informal drawings, and inventor's declaration.

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Request for Formal Patent Application  
Attorney Docket No. 1.068US  
April 28, 2000  
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**CALCULATION OF FEE**

Basic Fee	\$ 690.00
Additional Fees:	
Number of independent claims is 2.	
Number of dependent claims is 10.	
Number of total claims is 12.	

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<b>TOTAL FEES FOR THE ABOVE APPLICATION</b>	<b>\$ 690.00</b>
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Please charge \$690 for the filing fee to Deposit Account  
Number 50-0964. A duplicate copy of this page is enclosed.

Please address all correspondence regarding this application  
to the person named below:

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Respectfully submitted,

28 April 2000

Date



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REAL TIME FAX-OVER-PACKET PACKET LOSS COMPENSATION

\* \* \* \* \*

CROSS-REFERENCE TO RELATED APPLICATIONS

5 Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

10 BACKGROUND OF THE INVENTION

This invention relates to facsimile transmission over packet networks. In particular, the present invention relates to the repair of scan line errors in fax over packet transmissions.

15 When dedicated facsimile devices communicate directly, a series of command signals are exchanged which allow the devices to communicate. The control information includes training to accommodate the speed and specifications available at both ends of the transmission and communications to ensure that the  
20 connection is not corrupted or interrupted. The exchange of data is direct, without delay or translation. Because of this direct connection, facsimile equipment is designed to function properly with a constant connection and not in an environment where the connection is intermittent or interrupted. If a facsimile device  
25 detects an interruption/error in transmission, the facsimile device interprets this as a transmission error and will time out

and disconnect or attempt to retrain the current transmission. Retraining, if successful, will often result in a slower transmission speed in an attempt to avoid additional errors, hang-up and/or loss of transmission. Newer facsimile devices may also incorporate error correction mode capabilities which will compensate for limited interruption/error in transmission of image data.

When facsimile devices are connected through a packet network, they are not directly connected. The facsimile information is packetized at a sending end, sent over the packet network and reassembled into a facsimile format at the receiving end before presentation to the receiving facsimile device. The Connection over a packet network is not a constant connection and often experiences line delays, errors and/or packet loss which must be hidden from the facsimile device by a gateway in order to avoid error detection by a facsimile device attempting to communicate over a packet network.

Typically, low speed (T.30 hand shaking) control data is protected by simple redundancy techniques in fax over packet applications to combat network packet loss. The repetition of control data helps to insure that the facsimile devices receive an essentially uninterrupted control signal even in the event of packet loss, essentially fooling the facsimile device into believing that it has an uninterrupted direct constant connection

to the facsimile device on the other side of the connection. The repetition of control data has negligible network bandwidth impacts because of the small size of control data and produces significant benefits to call success rates.

5

High-speed, large size, image data is not protected through repetition, because of undesirable increases in network bandwidth requirements. Prior to the present invention, the loss of image data causes page errors in the receiving facsimile device, causes  
10 loss of connection and excessive retraining which can significantly increase the time of transmission and loss of image data results in errors in the printed document. Error Correction Mode (ECM) employed by most newer fax devices can combat packet loss to a limited extent but may only result in the  
15 problems associated with excessive retraining and retransmissions.

In ECM mode of operation, when network packet loss exceeds two to three percent, ECM becomes ineffective and leads to  
20 consistent call failures when high-speed data is not protected over the network. When packet loss exceeds two to three percent, it has been observed that there is continuous data retransmission requests and re-trains. Eventually, the facsimile device gives up and terminates the call unsuccessfully. Disabling the ECM  
25 mode in packet loss environments exceeding two to three percent would improve performance.



The apparatus and method of the present invention are compatible with a fax relay operation.

The apparatus and method of the present invention  
5 accomplishes the above objectives and the further benefits of the elimination of retrains due to packet loss which leads to improved facsimile performance.

Call success is improved with legacy facsimile devices that  
10 cannot tolerate page data errors with the apparatus and method taught herein. Because the invention is able to maintain minimal intervention so that only page errors due to network packet loss are concealed. Page errors due to equipment error or PSTN errors will be passed through and handled by the end point facsimile  
15 devices. The algorithm of the present invention operates in the re-modulating gateway with no dependencies on the demodulating gateway.

Overall page quality is still degraded due to packet loss,  
20 however, the call will not be terminated, resulting in over transmission success. The receipt of degraded facsimile is preferable to no receipt. If necessary, the recipient can request retransmission if the extent of degradation is unacceptable. The extent of degradation depends on the page  
25 content, e.g. text, pictures, density and the like. Therefore, call success rates are drastically improved.

## BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the nature of the present invention, reference is had to the following figures and detailed description, wherein like elements are accorded like reference numerals, and wherein:

Figure 1 is a diagram of the interconnection of facsimile over packet network.

Figure 2 is an exemplary logic flow diagram of the method of implementation of the present invention.

## DETAILED DESCRIPTION OF PREFERRED EXEMPLARY EMBODIMENTS

In an non-ECM environment, only Modified Huffman MH and Modified Read MR page compression techniques are available. The algorithm of the present invention for concealing page errors due to packet loss is similar for Modified Huffman (MH) and Modified Read (MR) page compression modes.

Figure 1 illustrates the connection of a first facsimile device 11 through a local gateway 15 to a packet network 17. At the other side of the packet network 17 is a gateway 19 and a second facsimile device 21. Prior to the implementation of the present invention, a facsimile transmission from facsimile device 11 is transmitted through gateway 15 where it is packetized and



sent to packet network 17. Packet data is received from the packet network 17 by gateway 19 and reassembled in proper order in a buffer at the gateway 19. The image data was then played out from the buffer to the receiving facsimile device 21 as it  
5 was reassembled.

The facsimile device 21 assembles the image data into scan lines and prints the facsimile. In the event of packet loss, the image data played out to the receiving facsimile device 21 would  
10 contain errors because it is incomplete. The receiving facsimile device 21 would detect a page error and react accordingly.

The scan line repair algorithm of the present invention is illustrated in Figure 2. Image data received by gateway 19, from the packet network 17, is parsed into scan lines. The Scan line data is buffered and not played out to the local Facsimile Termination Equipment (FTE) 21 until the end of the scan line is expected with no packet loss.  
15

If packet loss is expected before the end of the current scan line, the buffered scan line data is discarded and zero fill is played out to the local FTE 21, replacing the damaged scan line data.  
20



The reduced code complexity is due primarily to the concept of scan line deletion as compared to replaying previous scan line data and/or lines. While repeating scan lines may in some instances improve printed page quality, it has greater code and data memory requirements and can cause a reduction in image quality dependant upon the image content.

Because many varying and different embodiments may be made within the scope of the inventive concept herein taught, and because many modifications may be made in the embodiments herein detailed in accordance with the descriptive requirements of the law, it is to be understood that the details herein are to be interpreted as illustrative and not in a limiting sense.

WE CLAIM:

1. A method for reducing facsimile page errors due to packet loss in facsimile transmission over a packet network, comprising the steps of:

5 receiving facsimile image data packets from a packet network;

reassembling said received packets;

parsing said assembled packets into scan line data of said facsimile image;

10 evaluating said scan line data to detect the expected end of a scan line without packet loss;

playing out said scan line data to the local FTE if said scan line data has no packet loss; and

15 discarding said scan line data if said scan line data has packet loss.

2. The method of Claim 1, further comprising the steps of: replacing said discarded scan line data with zero fill data; and

20 playing out said zero fill data to said local FTE.

3. The method of Claim 1, further comprising the step of: replacing said discarded scan line data with scan line data defining a blank scan line.

25

4. The method of Claim 1, further comprising the step of:  
replacing said discarded scan line data with a repetition of  
the previous scan line.

5 5. The method of Claim 1, further comprising the step of:  
buffering said scan line data;

6. The method of Claim 2, further comprising the steps of:  
continuing to provide zero fill data to said local FTE;  
10 monitoring said scan line data for the start of the next  
detected scan line;

buffering said next detected scan line data;  
evaluating said next detected scan line data to detect the  
expected end of a scan line without packet loss;

15 playing out said next detected scan line data to the local  
FTE if said scan line data has no packet loss; and

continuing to provide zero fill data to said local FTE if  
said scan line data has packet loss.

20 7. A device for reducing facsimile page errors due to  
packet loss in facsimile transmission over a packet network,  
comprising:

a gateway for receiving facsimile image data packets from a  
packet network;

25 a processor for reassembling said received packets, parsing  
said assembled packets into scan line data of said facsimile

image, evaluating said scan line data to detect the expected end  
of a scan line without packet loss, playing out said scan line  
data to the local FTE if said scan line data has no packet loss;  
and for discarding said scan line data if said scan line data has  
5 packet loss.

8. The apparatus of Claim 7, wherein said processor  
further replaces said discarded scan line data with zero fill  
data and plays out said zero fill data to said local FTE.

9. The apparatus of Claim 7, wherein said processor  
further replaces said discarded scan line data with scan line  
data defining a blank scan line.

10. The apparatus of Claim 7, wherein said processor  
further replaces said discarded scan line data with a repetition  
of the previous scan line.

11. The apparatus of Claim 7, further comprising a buffer  
20 for buffering said scan line data;

12. The method of Claim 8, wherein:  
said processor further continues to provide zero fill data  
to said local FTE while monitoring said scan line data for the  
25 start of the next detected scan line;  
said buffer stores said next detected scan line data;

said processor evaluates said next detected scan line data  
to detect the expected end of a scan line without packet loss,  
plays out said next detected scan line data to the local FTE if  
said scan line data has no packet loss or continues to provide  
5 zero fill data to said local FTE if said scan line data has  
packet loss.

\* \* \* \* \*

## ABSTRACT OF THE INVENTION

A device and method for providing real time compensation for packet loss in the transmission of facsimile data over packet networks to avoid the generation of page loss data and the termination of facsimile transmission. Facsimile devices have a low tolerance for interruptions in transmission. Packet networks commonly have a transmission interruption rate above the tolerance of facsimile equipment. In order to compensate for transmission interruption, the present invention teaches the buffering of facsimile data by scan line at the receiving end, the evaluation of buffered scan lines for packet loss and the discarding of scan lines having packet loss to conceal the packet loss from the receiving facsimile equipment to avoid detection of page errors by the receiving facsimile equipment which could cause loss of facsimile transmission. Discarding damaged scan lines instead of repair or replacement saves computational time and storage capacity, allowing for real-time compensation to provide for optimal transmission.

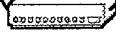


11



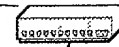
Fax

15



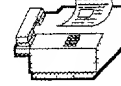
Gateway

19



Gateway

21



Fax

FIGURE 1

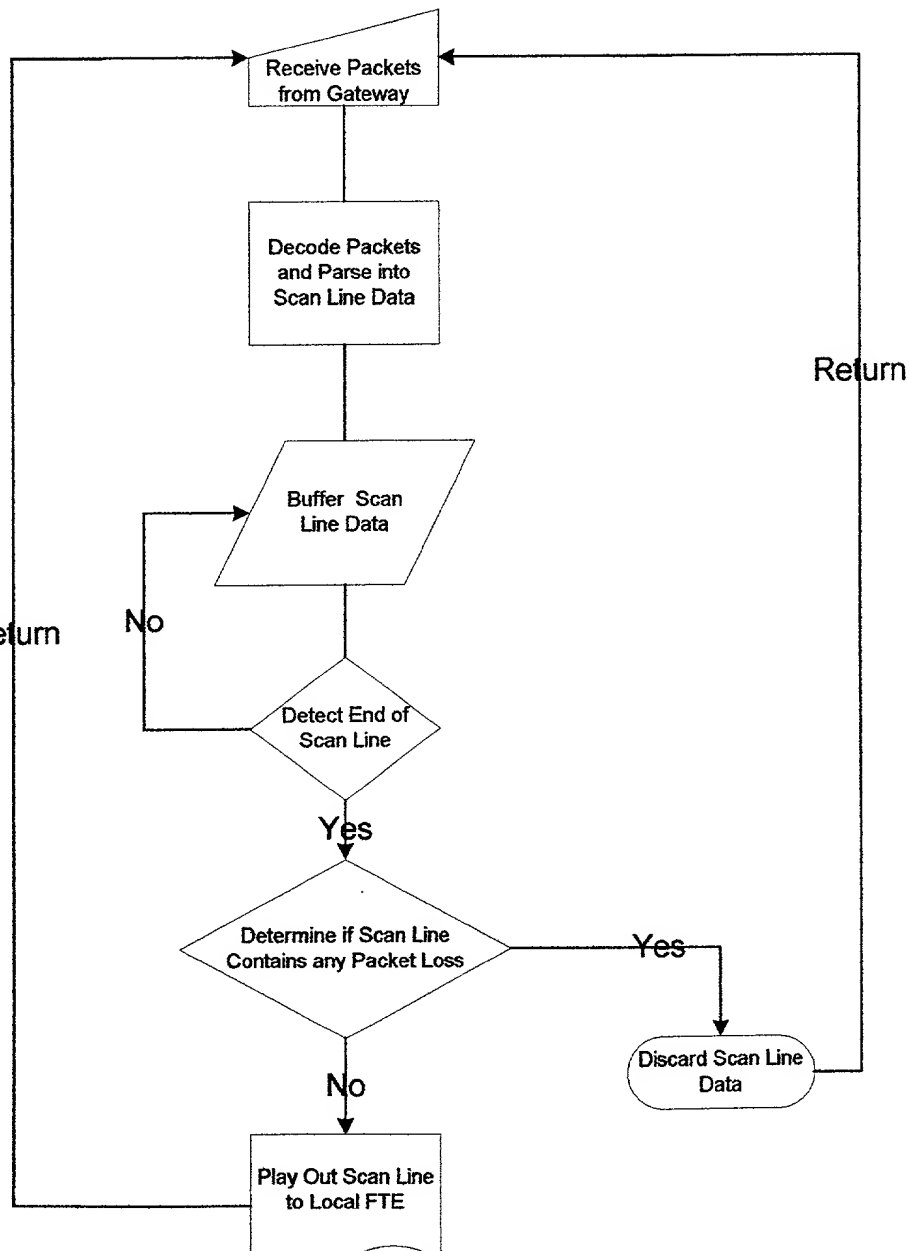


FIGURE 2

**DECLARATION**

AS THE BELOW NAMED INVENTORS, we declare that:

Our residence, post office address, and citizenship are as stated next to our names. We believe that we are the original, or an original, first and joint inventor, of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE: **REAL TIME FAX-OVER-PACKET PACKET LOSS COMPENSATION**

the specification of which either is attached or otherwise accompanies this Declaration, or

☒ is attached to the application being filed today, \_\_\_\_\_.

☐ was filed in the U.S. Patent and Trademark Office on \_\_\_\_\_, 2000, and assigned Serial No. \_\_\_\_\_.

☐ and (if applicable) was amended on \_\_\_\_\_.

We state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56. We further acknowledge, in the case of any application filed pursuant to Title 35, United States Code, § 120 (and which discloses and claims subject matter in addition to that disclosed in the prior copending application), the duty to disclose all information known to the persons to be material to patentability as defined in 37 C.F.R. § 1.56 which information became available between the filing date of the prior application and the national or PCT international filing date of the subject 35 U.S.C. § 120 application.

We claim foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventors' certificate listed below and have also identified below any foreign application for patent or inventors' certificate having a filing date before that of the application on which priority is claimed:

Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	(Application Number)	(Country)	(Day/Month/Year filed)

We claim the benefits under Title 35, United States Code, § 120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application(s) in the manner provided by the first paragraph of Title 35, United States Code, § 112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a), which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

**None**

(Application Serial No.)	(Filing Date)	(STATUS: patented, pending, abandoned)

We appoint the following attorneys, Paul Grandinetti, Reg. No. 30,754, James L. Lewis, Reg. No. 24,732, and Joseph J. Zito, Reg. No. 32,076, to transact all business in the U.S. Patent and Trademark Office connected therewith and with any divisional, continuation, continuation-in-part, reissue, or reexamination application, with full power of appointment and with full power to substitute an associate attorney or agent, and to receive all patents which may issue thereon. We request that all correspondence be addressed to:

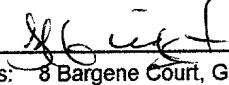
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**INVENTORS' DECLARATION**Attorney Docket No. TEL1.068US

Real Time Fax-Over-Packet Packet Loss Compensation

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WE DECLARE that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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